ECONOMIC IMPLICATIONS OF REDUCING THE SIZE LIMIT ON KING CRAB

by

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Regional Information Report No. 5J92-10

Alaska Department of Fish and Game
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P.O. Box 25526
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November 1992

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ACKNOWLEDGMENTS

Much of the information presented in this report was based on Sarah Bibb's thesis for a Master of Arts in Agricultural Economics. Dr. Ron Mittelhammer and Dr. Vicki McCracken of Washington State University made substantial contributions to the development of that research.

PROJECT SPONSORSHIP

This report is based on research that was partially financed by the Alaska Department of Fish and Game under cooperative agreement COOP-90-004 with Washington State University.

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ABSTRACT

Depressed Alaskan king crab Paralithodes camtschaticus stocks and industry profitability provide impetus for a policy change to reduce harvest size limits. A model was developed for wholesale price determination for frozen king crab legs and claws, graded by size and species, sold in the domestic market. This model was used to assess the wholesale price and revenue consequences of lowering the size limit on king crab. A reduced size limit policy that maintained current quotas and redistributed catch from larger sizes to the smallest size could either increase revenues very slightly or lower revenues. Revenues would climb if total catch were to increase as a result of harvesting more small crab.

ECONOMIC IMPLICATIONS OF REDUCING THE SIZE LIMIT ON KING CRAB

INTRODUCTION

A decade after the Alaskan king crab Paralithodes camtschaticus fishery began its collapse, crab stocks and industry profitability remain depressed. Yet, fleet capacity continues to grow. The shrinking end-of-year "bottom line," especially among fishermen who tend to be less diversified than processors, has provided a strong impetus for considering a harvest size limit reduction. Advocates of such a policy change purport several potential benefits:

1. Reduced harvest pressure on larger males, which some believe may contribute more to reproductive success than the more abundant, smaller sublegal males.

2. Handling mortality in the directed fishery by increasing catch per unit effort (CPUE), and decreasing the number of sublegal discards.

3. Enhanced economic performance of fishermen from raising CPUE.

Unfortunately, biological justification of a size limit reduction is highly speculative. This is especially true in a long-run context because king crab are so long lived. A change in either the size structure or magnitude of the current harvest will directly impact legal crab stocks for many years. And indirectly, stocks are impacted well into the future through altered reproductive potential. Details of this complex dynamic population structure are not well studied. Moreover, the implications of lowering per unit harvest costs, or higher CPUE, is a separate question from how changes in the size structure of the catch translate into wholesale or exvessel prices and, ultimately, industry revenues.

The objective of this report is to develop a preliminary model of wholesale price determination for frozen king crab legs and claws, graded by size and species, and sold in the domestic market. This model is used to assess the wholesale price and revenue consequences of lowering the size limit on king crab.

CONCEPTUAL CONSIDERATIONS

Each pack count category of king crab legs and claws can be thought of as a distinct product. Accordingly, wholesale buyers view the decision to purchase a particular product size in the context of a variety of close substitutes. A given buyer may enter the market with a preference for one specific size. That preference is determined, to a considerable extent, by the buyer's market niche. But price and availability of close substitutes, especially adjacent size categories, affect the eventual purchase. It is precisely this substitution possibility among the various product sizes that determines the primary economic consequences of reducing the size limit.

Consider the following simplified view of the inherent substitution relationships. An increase in the supply of the smallest size category (20/25s) will lower the wholesale price of that pack count. It also will reduce the demand for the next larger size category (16/20s). As the price spread between 20/25 and 16/20 count crab widens, some wholesale buyers will substitute the relatively less expensive smaller crab for the otherwise preferred larger crab in the adjacent size category. The reduced demand for the 16/20 count crab will translate into a lower price for that product, which, in turn, will depress the demand and price of the next larger pack count, and so on. The recursive logic of this substitution process extends to all size categories, ultimately affecting even the largest product size (9/12s).

This simplified example serves only to illustrate the linkage among size-graded products. It does not necessarily reflect how prices will eventually adjust. Price is determined by both demand and supply considerations, not just demand. It follows that measuring the extent of price adjustments is an empirical problem, though one can expect the price effects to diminish as the substitution effects weaken, i.e., as product size increases.

There often is a tendency to regard falling prices as an indicator of falling revenues and rising prices as an indicator of rising revenues. Unfortunately, translating price movements into revenue swings is not so simple. Falling prices can trigger either falling revenues or rising revenues, depending upon the "elasticity" or responsiveness of supply and demand. If price drops but quantity sold increases proportionately more, revenues will climb. Conversely, revenue will fall if the percentage increase in quantity sold is less than the percentage decrease in price. Thus, predicting the revenue implications of a size limit change also is an empirical problem.

The conceptual process of analyzing how size-graded king crab legs and claws substitute for each other is similar to any other graded food commodity, e.g., apples or beef. The process involves estimating supply and demand relationships for each size grade. And, because the prices of all grades are interdependent, the system of demand and supply equations should be estimated simultaneously. These statistical estimates then may be used to simulate the likely price and revenue consequences of reducing the size limit.

SPECIAL DATA CONSIDERATIONS

There are several complicating factors that make demand/supply analysis particularly difficult for king crab. These factors include (1) an absence of published price/quantity data, (2) difficulties in measuring inventories, and (3) brevity of the data series that could be compiled.

Price/Quantity Data

Despite the long tradition of selling king crab by size and species in the domestic wholesale market, there is no corresponding published price and quantity data. The only available published data on weekly wholesale prices of king crab legs and claws are from the National Marine Fisheries Service (NMFS) and Urner Barry Seafood Price Current (SPC). Neither source reports quantities sold, and NMFS did not begin discriminating by size or species prior to November 1989.

Accordingly, major shore-based processors and independent catcher-processors were asked to provide three years of data (1987-89) for this study. Independent catcher-processors, in general, did not have computerized records over this period, and several shore-based processors were unwilling to cooperate. Data from one shore-based processor who agreed to participate was not used; the financial relationship between that processor and its principal domestic customer may have influenced wholesale price. The remaining participants were all shore-based processors representing 40% of domestic king crab sales during 1988.

Data collected from participating processors included date of sale; product form, including species and size; pounds sold; wholesale price per pound; transportation cost per pound; location where title of product transferred; other price adjustments per pound; and a customer identification number. Processors also were asked to identify all buyers so specific buyer demand characteristics, such as the relationship between buyer and seller, the type of retail market, annual volume, etc., could be ascertained. Unfortunately, one participant declined to provide this customer information, so no information about buyers could be used in this study. Omission of this one piece of information compromised subsequent analysis. Buyer characteristics and market niches could not be used to help determine demand for a particular product.

Complete sales data from all participants were available only for the 32 month from May 1987 through December 1989. This limited the analysis to the 1987-88 and 1988-89 marketing years, which begin in September. The final data set represented domestic sales of king crab legs and claws graded by species and size and packed into 20 pound boxes. Wholesale price was adjusted for each sale to an FOB Seattle price by subtracting broker fees and transportation costs. The individual sales were aggregated to a monthly basis in order to protect confidentiality of individual processor data.

Lack of an industrywide grading standard resulted in pack-count categories that differ somewhat among participants. A standardized pack-count classification was imposed on the data set based on advice from industry members. Legs and claws were divided into 10 species/size categories. The name of the product form, which specifies both species and size, as well as the name of the wholesale price variables are listed in Table 1. For example, PR9/12 refers to the price per pound of 9/12 count red king crab legs and claws.

Table 1. King crab legs and claws product forms and variable names by species and size.

Species and Size	Price Variable	Species and Size	Price Variable
Red 9/12	PR9/12		
Red 12/14	PR12/14	Gold 12/14	PG12/14
Red 14/16	PR14/16	Gold 14/16	PG14/16
Red 16/20	PR16/20	Gold 16/20	PG16/20
Red 20/25	PR20/25	Gold 20/25	PG20/25
		Gold 24/up	PG24/up

Some size classes were combined for each species. The categories Red 14/16 and Gold 14/16 include sales of both 14/16 count and 14/17 count product. Similarly, Red 20/25 includes sales of Red 20/24, Red 20/25, and Red 21/24. Gold 20/25 includes sales of Gold 20/24, Gold 20/25, and Gold 21/24. Gold 20/up includes sales of Gold 20/up, Gold 24/up, and Gold 25/30. Red 20/up and Gold 9/12 were not considered in this analysis because of the extremely limited sales volume.

Monthly average wholesale prices are listed in Appendix A for both red and golden king crab, by size category. These prices represent weighted average prices across the participating firms, the weights being monthly sales volume.

Inventory Considerations

One would generally expect that prices firm as available inventories diminish throughout the year. Unfortunately, beginning of month inventory figures provided by processors did not reflect the true availability of king crab product throughout the year. During a given month, a processors can produce more product by reprocessing bulk king crab into graded product, or by purchasing graded product from other processors. It is not uncommon for sales of a particular species and size to occur in a month when beginning inventories were zero, or for pounds sold to be greater than beginning inventory. Thus, beginning of month inventory figures supplied by the processors were not used in this analysis.

Instead, total available supplies of red king crab graded by size were computed based on cumulative annual sales of the processors surveyed, less their monthly sales. This measure of supply is presumed to be known before the marketing season since processors know total catch, exports to Japan, and the general size distribution of bulk processed crab. Inventories in October of each year were set equal to total annual sales of the particular size class. Beginning inventories in successive months were calculated by subtracting monthly sales from prior month stocks. Inventory and sales data are presented in Appendix B.

No such available supply measure could be compiled for golden king crab Lithodes aequispina because they are managed without a quota or harvest guideline range, and harvests occur during each month of the year. Processors have very limited ability to predict the amount or size distribution of golden king crab. Inability to construct a measure of total available supply of golden king crab meant that a critical variable in modeling price determination was missing. For this reason, the analysis had to be limited to the study of red king crab pricing.

Brevity of Data Series

Only 24 of the 32 monthly observations on red king crab prices and inventories could be used to reflect two complete marketing years: 1987-88 and 1988-89. This short time series contributed to two analytical problems. First, it eliminated inclusion of consumer income which normally is an important explanatory variable of consumer demand. There simply is insufficient variation in consumer income measures, such as per capita disposable income or per capita food expenditures away from home, over a two-year period to have any statistical relevance.

The short time series created an additional statistical problem related to the interdependence of all size-graded product prices. A compromise model specification had to be adopted that related the price of each size category only to the prices of adjacent size categories, rather than the prices of all sizes.

EMPIRICAL MODEL

Details concerning all aspects of model development and estimation are available in Bibb (1990). It suffices here to summarize the essence of the model. Five price equations were estimated, one for each size-graded red king crab product. All five equations had the same general form. The monthly price of each size was estimated as a function of (1) the seasonal average exvessel price, which is the processors main cost of production, (2) the price(s) of adjacent size categories, (3) the remaining inventory of the particular product size, and (4) the price of frozen Australian lobster tails, which is considered a close out-of-species substitute. The statistical estimation included five such equations, one for each standardized pack count (9/12, 12/14, 14/16, 16/20, and 20/25 count boxes of legs and claws).

Interpretation of the statistical model results is slightly more complex than encountered with single-equation models. This is because all equations are interrelated by including the prices of adjacent king crab size(s) as explanatory variables. Whatever influences the price of one size, ultimately affects the prices of all sizes. This cross-equation influence of king crab prices must be accounted for in any price prediction. That is, it is necessary to capture both the direct and indirect effect of a change in the remaining explanatory variables when predicting prices. The indirect effect is nothing more than the influence of a change in a particular explanatory variable as its effect filters through the system of price equations.

Table 2 shows the composite impact that a change in each explanatory variable is estimated to have on a particular price equation. This table entries, referred to as "reduced form multipliers," were derived from the statistical estimates of the price equations discussed previously.

The reduced form multipliers suggest that processors operate ostensibly on a cost plus pricing basis. The exvessel price multiplier indicates the change in domestic wholesale price resulting from a unit change in exvessel price, all other things being equal. From 1987-89, this change was approximately 1.5 to 2.0 times input costs, as measured by exvessel price. The greatest changes occurred with the 14/16 and 12/14 pack counts. In addition to the effects of exvessel price, wholesale prices are adjusted by remaining inventories (measured in 1,000 pounds) and the price of the lobster tail substitute. The low negative multiplier on INV9/12 through INV20/25 indicate that changes in stock levels have only minor impact on general price level. Lobster prices, however, appear to have a relatively important influence on the wholesale price of king crab in this model. A $1.00 increase in the price of lobster (at the sample mean values) yields from $0.11 per pound to $0.28 per pound increase in the price of red king crab.

Table 2. Reduced form multipliers for red king crab wholesale prices

Dependent Variable	Explanatory Variables						
	PEXR	PLOBA	INV9/12	INV12/14	INV14/16	INV16/20	INV20/25
PR9/12	1.6230	0.2816	-0.00840	-0.00058	-0.00016	-0.00011	-0.00016
PR12/14	1.9919	0.1512	-0.00171	-0.00134	-0.00038	-0.00026	-0.00037
PR14/16	2.0117	0.1128	-0.00087	-0.00069	-0.00104	-0.00072	-0.00100
PR16/20	1.7636	0.1444	-0.00033	-0.00026	-0.00040	-0.00195	-0.00272
PR20/25	1.5346	0.1761	-0.00011	-0.00008	-0.00013	-0.00063	-0.02165

Variable Definitions:

PR - Domestic wholesale price of size-graded 20-lb box, red king crab legs and claws.
PEXR - Seasonal average exvessel price for red king crab.
PLOBA - Price of 8-10 oz frozen Australian lobster tails, mid-Atlantic coast.
INV - Remaining annual inventory of size-graded product, seasonal year, measured in thousand pounds.

SIMULATING THE CONSEQUENCES OF A REDUCED SIZE LIMIT

Any consideration of a reduced size limit implies a new, smaller grade. However, there is no way to predict prices and sales of smaller crab. Nor is there any statistical way to estimate how a new, smaller grade will affect the substitutional relationships across the larger grades. Accordingly, this analysis simulates the influence of a size-limit reduction by increasing the available supply of the smallest current size category (20/25 count). This increase in supply of 20/25s is achieved under three different policy scenarios, each reflecting alternative ways that a size limit policy change might be achieved. The economic consequences of the policy change is evaluated by comparing the resulting predicted prices, and thus, industry revenues, with those of a baseline or "Historical Scenario."

The Historical Scenario uses the multiplier matrix in Table 2 to "hindcast" monthly prices by size, assuming actual historical monthly inventories, exvessel prices, and lobster prices. Cumulative industry revenues, measured in October 1989 dollars, then are calculated. Total revenues reflect only the portion of the industry represented by the survey participants.

The first two reduced size-limit scenarios predict prices and revenues assuming quantities sold are identical to historical, 1987-88 and 1988-89 levels. These represent policies of reducing the size limit while holding total annual harvest constant. The distribution of product is adjusted so that 20/25s represent 10% of total annual quantities sold in each year instead of 6.1% and 5.7%, respectively. See Table 3 for the actual total pounds sold and distribution by size. Scenario 1 assumes a uniform impact on harvest. Redistribution of total harvest is achieved by subtracting an equal percentage amount from

the four larger pack counts (0.958% in the first year and 0.954% in the second year). Scenario 2 assumes the reduced size limit will have a disproportionate impact on the larger sizes. This possibility was modeled by redistributing product such that 25% of the increase in 20/25 count quantity sold is removed from each of the four larger pack counts.

Table 3. Total pounds sold and distribution by size under historical conditions and alternative policy scenarios, 1987-88 and 1988-89

Year	Product	Historical	Policy Scenario 1	Policy Scenario 2	Policy Scenario 3
1987-88					
	9/12	46,480	44,539	35,895	46,480
		4.44%	4.25%	3.43%	4.27%
	12/14	306,380	293,870	295,804	306,380
		29.23%	28.04%	28.23%	28.13%
	14/16	357,080	342,165	347,157	357,080
		34.07%	32.65%	33.13%	32.79%
	16/20	274,390	262,929	264,363	274,390
		26.18%	25.09%	25.22%	25.19%
	20/25	63,690	104,802	104,802	104,802
		6.08%	10.00%	10.00%	9.62%
Total Sales		1,048,020	1,048,020	1,048,020	1,089,132
		100.00%	100.00%	100.00%	100.00%
1988-89					
	9/12	22,580	21,549	14,376	22,580
		3.23%	3.08%	2.06%	3.09%
	12/14	201,460	192,259	193,936	201,460
		28.80%	27.49%	27.72%	27.61%
	14/16	224,520	214,266	217,020	224,520
		32.10%	30.63%	31.03%	30.77%
	16/20	211,120	201,478	203,729	211,120
		30.18%	28.80%	29.12%	28.94%
	20/25	39,820	69,950	69,950	69,950
		5.69%	10.00%	10.00%	9.59%
Total Sales		699,500	699,500	699,500	729,630
		100.00%	100.00%	100.00%	100.00%

The third policy scenario also assumes catch and thus quantities sold of 20/25s increase to 10% of total annual quantity sold. However, Scenario 3 treats this increase as a net addition to total quantity sold. It follows that this scenario represents a management policy of enlarging total harvest.

Predicted Prices

Predicted monthly prices-by-size are enumerated in Appendix C.1 for the historical and three alternative policy scenarios. Weighted average annual prices are summarized in Table 4. These results show that a reduced size limit policy has the greatest impact on price of the smallest size crab. Average prices of 20/25s dropped $0.50/lb in the first year and $0.37/lb in the second year due to the increased sales. Price of the adjacent pack count (16/20s) dropped $0.06-$0.08/lb the first year, but only $0.02-$0.03/lb the second year. Differences in magnitudes between years is a consequence of cumulative quantity sold. Thirty-three percent more crab were sold in the 1987-88 marketing year.

Table 4. Weighted average annual wholesale prices by size of red king crab legs and claws: historical and alternative policy scenarios.

Year	Product	Historical ($/lb)	Policy Scenario ($/lb)		
			1	2	3
1987-88					
	9/12	10.25	10.27	10.31	10.25
	12/14	9.91	9.91	9.92	9.90
	14/16	9.30	9.29	9.29	9.27
	16/20	8.75	8.69	8.69	8.67
	20/25	7.89	7.38	7.38	7.38
1988-89					
	9/12	12.09	12.10	12.13	12.09
	12/14	12.19	12.20	12.20	12.19
	14/16	11.64	11.64	11.64	11.63
	16/20	10.79	10.77	10.77	10.76
	20/25	9.78	9.41	9.41	9.41

The particular policy scenario had little effect on the level of price changes. A notable exception relates to the price of 9/12s under Scenario 2. Price **increased** $0.04-$0.06 per pound. This scenario reflects a considerably reduced harvest of the largest crab. The large percentage reduction in first year volume sold of 9/12 count crab more than offset any weak substitution effects that trickle down from the much less expensive 20/25 count crab.

Predicted Revenues

Total revenues (October 1989 dollars) generated under each scenario are listed in Table 5. These revenue predictions portray a partial image of how industry well-being is likely to be impacted by a

reduced size-limit policy. It is immediately apparent that unlike prices, processing revenues depend upon the way in which a size limit reduction is achieved. Revenues are shown to rise slightly under Scenario 1, drop under Scenario 2, and rise under Scenario 3.

Table 5. Total revenue from red king crab sales under historical conditions and three scenarios of sales and product distribution (value as of October 1, 1989).

Product	Historical	Policy Scenario		
		1	2	3
9/12	$781,401	$755,948	$575,070	$781,172
12/14	5,726,174	5,530,418	5,525,044	5,721,994
14/16	6,062,893	5,976,899	5,877,960	6,049,278
16/20	4,803,874	4,688,176	4,609,274	4,552,131
20/25	937,131	1,504,613	1,502,655	1,501,883
Total	$18,311,473	$18,456,054	$18,090,003	$18,606,458

Revenues rise from $18.31 million to $18.46 million when total harvest is held constant and the size distribution is changed in a constant proportion. Only the 20/25 count revenues rise despite the $0.37-$0.50 price drop. The 10% increase in quantity sold of 20/25s exceeded the 4-6% price decrease.

Total revenues fall from $18.30 million to $18.09 million when the redistribution involves a constant quantity reduction (harvest) by size. Changes in individual pack count revenues follow a pattern similar to Scenario 1. Even the 9/12 revenues drop despite the $0.04-$0.06 average price rise. This result is a consequence of the relatively small percentage increase in price being more than offset by the larger percentage decline in quantity sold.

When total harvest is allowed to expand in order to increase the supply of 20/25s, revenue rises from $18.30 million to $18.61 million. Notice that even though total sales volume expanded less than 5%, and only in the smallest size category, the effect rippled upgrade. The adjacent larger size (16/20) revenues dropped more than $250,000.

CONCLUSIONS AND LIMITATIONS

The results of this analysis show that prices by size can change substantially and processor revenues can rise or fall depending upon how management policies affect the size structure of the catch. A reduced size limit policy that maintained current quotas and redistributed catch from larger sizes to the smallest size could either increase revenues very slightly or lower revenues. Revenues would climb if total catch were to increase as a result of harvesting more small crab.

These conclusions need to be put in a more complete policy perspective.

(1) Any reduced size limit policy will have long-term biological consequences that will "feed back" into altered economic performance over many years. A one- or two-year perspective is inadequate to judge the full merits or detriments of such a policy change.

(2) Processor revenues were used to indicate changes in general industry well-being, including the fishing sector. This broad inference is based on a proportional relationship between exvessel and average wholesale prices (see Matulich, Mittelhammer and Greenberg, 1990). That is, changes in average wholesale prices (revenues) transmit exvessel price changes, even though crab is not size graded at the exvessel level. However, there are several reasons to believe that gross wholesale revenues probably overestimate processor or industry well-being. First, lowering the size limit will create a new, smaller size category, which will face a lower price than 20/25s. Revenue estimates would decrease. Second, processor profitability is likely to shrink if the proportion of small crab increases. Per unit processing costs are greater for smaller crab. It follows that lower processing profitability should increase the margin between wholesale and exvessel levels. Third, a smaller category of king crab may compete out-of-species with the much lower priced Tanner crab *Chionoectes bairdi* or even golden king crab. If Tanner crab were perceived by the market as a substitute for a "25-and-up" count crab, the 25-and-up price would soften. Larger pack count king crab prices would soften in a manner similar to that shown in this report.

(3) Changes in wholesale revenues do not reflect any increase in harvest efficiency associated with higher CPUE. And a higher CPUE is likely with a lower size limit. It is conceivable, though probably not likely, that any loss in wholesale revenue could be offset by lower per-unit fishing costs.

A variety of caveats are appropriate with this type of analysis. Serious data limitations required model specification compromises. The most notable deficiency relates to an inability to identify buyer characteristics. For example, the data represent about 800 different customers. Yet, the top five customers reflect 30-40% of total sales by each processor. At the very least, type and size of buyer should be incorporated into the model. This was not possible for a variety of reasons, including the inability to identify the wholesale buyers from one participating processor.

Even if model specification compromises were not required, a two-year data series is inadequate to make reliable forecasts. Moreover, the data represent only 40% of the industry. Absence of catcher-processor data raises questions regarding the generality of implied pricing behavior. Catcher-processors are becoming relatively more important in this fishery and may exhibit different market behavior.

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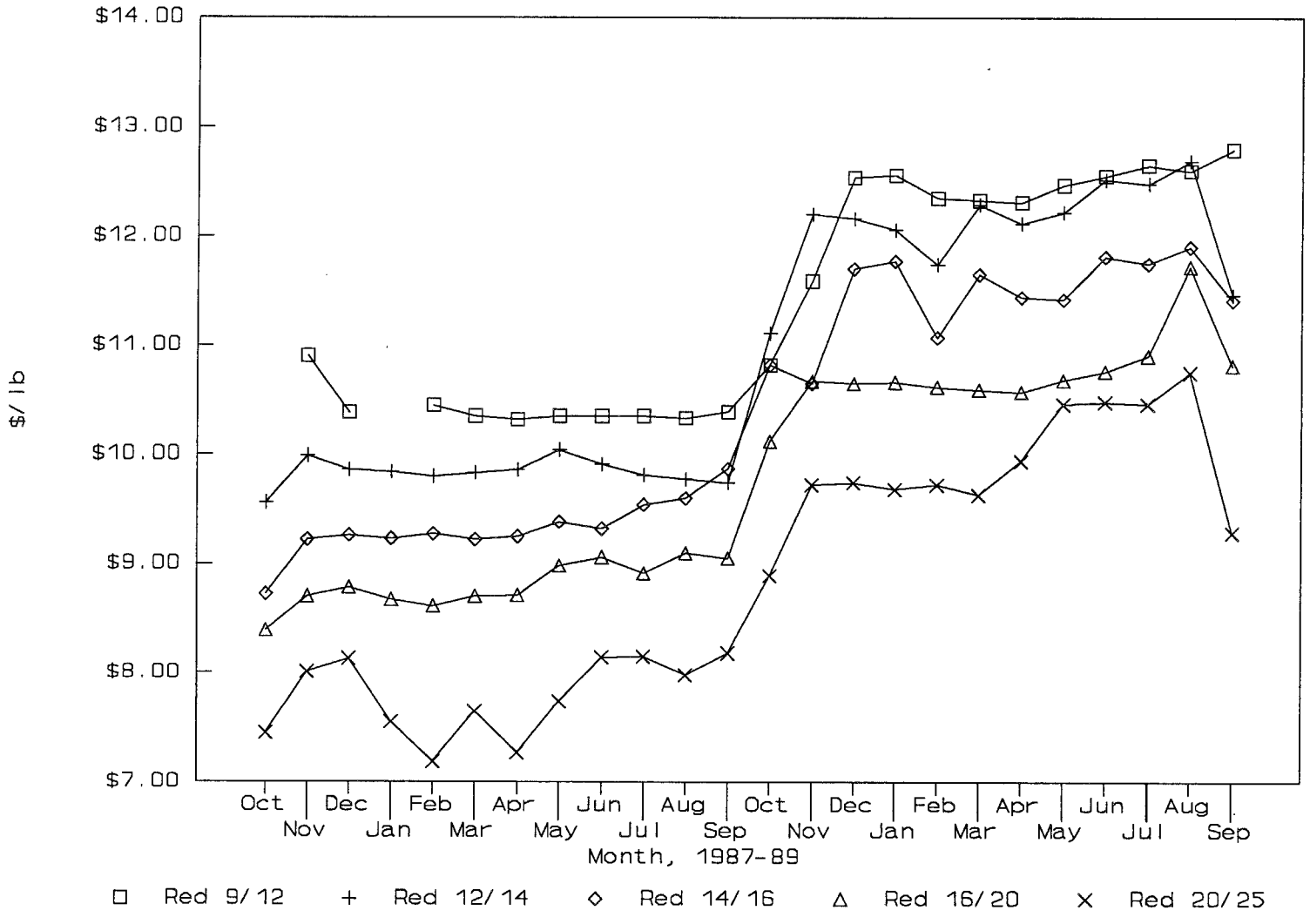
APPENDIX A: WEIGHTED AVERAGE PRICE DATA, RED AND GOLDEN KING CRAB

RED KING CRAB
WHOLESALE PRICES

Monthly weighted average domestic wholesale price for five sizes of red king crab are presented in Figure A.1. During the 1987-88 season, red king crab prices ranged from about $7.00/lb for small legs to nearly $11.00/lb for large legs. Price spreads between the adjacent size groups ranged from about $0.30 to $0.65/lb between Red 9/12 and Red 12/14; from $0.20 to $0.80 per pound between Red 12/14 and Red 14/16, and between Red 14/16 and Red 16/20; and from $0.75 to $0.45 between Red 16/20 and Red 20/25. The spreads were much more variable over time between smaller sizes than between larger sizes.

Price inversions occurred between the four largest size groups during September, October, and November 1988. In September 1988, Red 14/16 sold for $0.13/lb more than the larger sized Red 12/14. This price inversion also occurred in three other size categories. All inversions occurred at the end of a season suggesting that processors may discount the previous season's product in an attempt to sell it before newer product is inventoried.

Harvest declined from approximately 13.6 million pounds in 1987-88 to 8.8 million pounds in the 1988-89 season. This decline in catch is, in part, responsible for the 20 percent rise in average exvessel price ($4.10 to $5.08). Wholesale prices for red king crab were also higher during the 1988-89 season, ranging from approximately $9.00 to nearly $13.00/lb, but price spreads between sizes were much narrower, particularly with the larger-size crab. Monthly price variability within size category increased in comparison with the previous season for most sizes of red king crab.

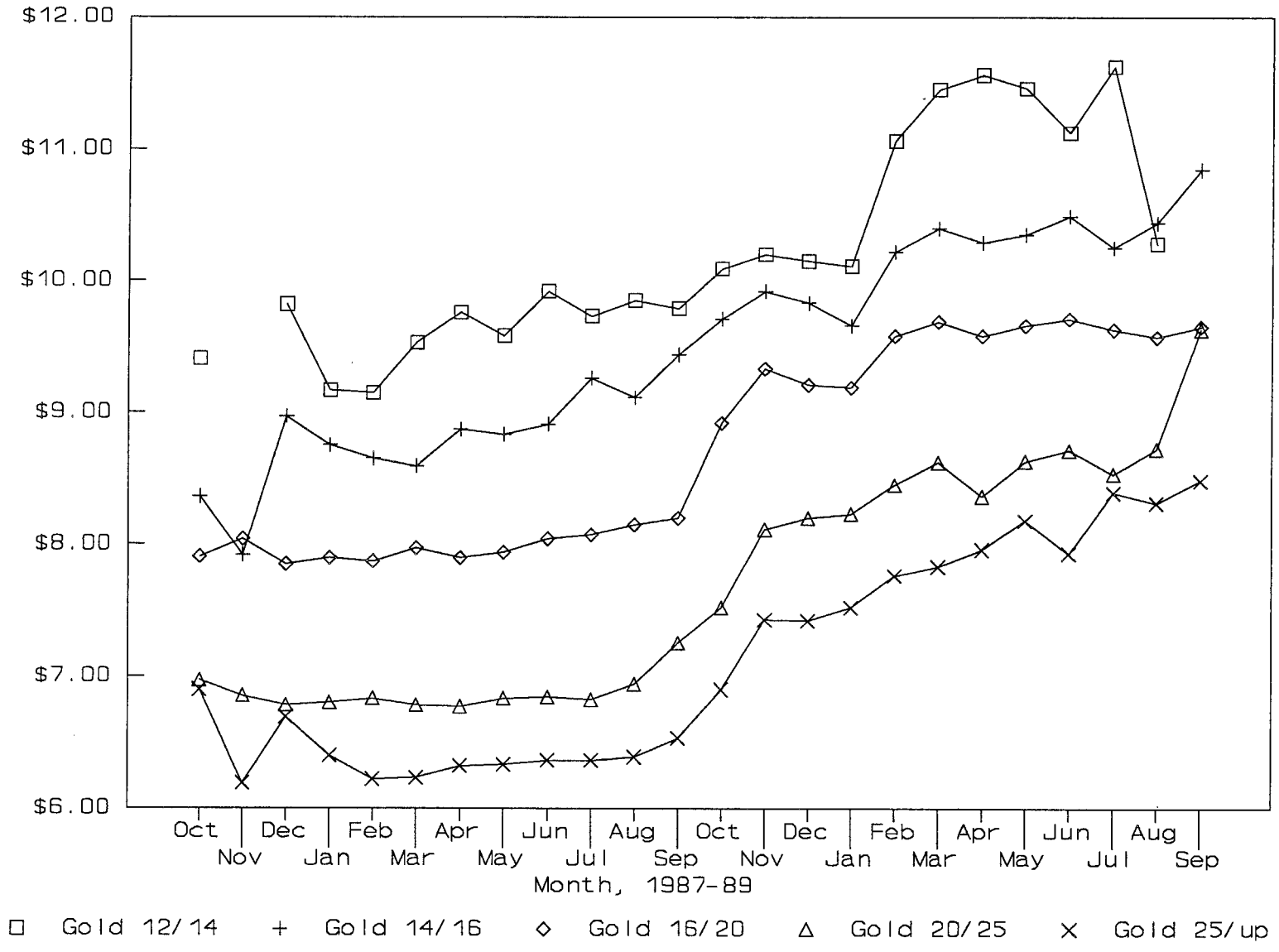


APPENDIX A.1. Monthly weighted average wholesale price for red king crab and claws, 1987-89.

GOLDEN KING CRAB
WHOLESALE PRICES

Monthly weighted average domestic wholesale price for five sizes of golden king crab are presented in Appendix A.2. Wholesale prices in 1988 ranged from about $6.00/lb for the smallest size category to over $10.00/lb for Gold 12/14. In 1989, wholesale prices for the same products ranged from about $7.50 to over $11.50. Price spreads between sizes in 1989 were generally larger and more variable than those in 1988.

Price spreads between the same size red and golden king crab legs and claws varied by pack count and time. In general, the cross-species price spreads were smaller and less variable during the 1987-88 red king crab seasonal year. For example, the price difference between Red 12/14 and Gold 12/14 ranged from -$0.10 to $0.70/lb from October 1987 through August 1988. The price spread widened to about $1.00 in September 1988, and then steadied at $2.00 for the remainder of 1988. It fluctuated between $0.50 and $2.40/lb during the next year. A similar pattern in the differences between the prices of Red 14/16 and Gold 14/16 occurred. In the smaller sizes, 16/20 and 20/25, price spreads fluctuated between $0.40 and $1.40 during the 1987-88 season and were as high as $2.20/lb during 1988-89.



APPENDIX A.2. Monthly weighted average wholesale price for golden king crab legs and claws, 1987-89.

APPENDIX B. Monthly poundage sold (QS) and remaining inventory (INV) of red king crab legs and claws sold in the United States by participating processors, 1987-1989.

Year	Month	Red 9/12		Red 12/14		Red 14/16		Red 16/20		Red 20/25	
		QS	INV	QS	INV	QS	INV	QS	INV	QS	INV
1987	Oct	0	46,480	12,080	306,680	20,060	357,080	15,740	274,390	1,700	63,690
	Nov	440	46,480	7,820	294,600	23,880	337,020	25,480	258,650	4,890	61,990
	Dec	3,280	46,040	73,120	287,080	12,360	313,140	17,180	233,170	1,940	57,100
1988	Jan	0	42,760	11,820	213,960	41,280	300,780	19,310	215,990	7,780	55,160
	Feb	4,000	42,760	6,340	202,140	31,300	259,500	49,620	196,680	500	47,380
	Mar	220	38,760	10,000	195,800	35,620	228,200	37,620	147,060	10,000	46,880
	Apr	4,420	38,540	38,800	185,800	58,220	192,580	35,080	109,440	440	36,880
	May	240	34,120	11,380	147,000	54,660	134,360	22,060	74,360	720	36,440
	Jun	1,240	33,880	47,080	135,620	47,020	79,700	22,080	52,300	4,440	35,720
	Jul	780	32,640	31,780	88,540	16,540	32,680	10,540	30,220	5,220	31,280
	Aug	26,680	31,860	42,500	56,760	14,980	16,140	15,680	19,680	9,580	26,060
	Sep	5,180	5,180	14,260	14,260	1,160	1,160	4,000	4,000	16,480	16,480
	Oct	740	22,580	9,260	201,460	5,760	224,520	14,320	211,120	2,880	39,820
	Nov	5,080	21,840	13,520	192,200	17,760	218,760	19,860	196,800	9,660	39,940
	Dec	6,400	16,760	15,860	178,680	25,580	201,000	11,140	176,940	4,100	27,280
1989	Jan	2,400	10,630	9,160	162,820	12,340	175,420	11,980	165,800	1,320	23,180
	Feb	2,400	7,960	28,520	153,660	19,900	163,080	8,340	153,820	940	21,860
	Mar	720	5,560	13,840	125,140	16,540	143,180	28,300	145,480	7,900	20,920
	Apr	2,920	4,840	19,560	111,300	18,180	126,640	27,860	117,180	4,500	13,020
	May	260	1,920	21,680	91,740	42,540	108,460	32,100	89,320	1,320	8,520
	Jun	240	1,660	17,680	70,060	15,420	65,920	25,260	57,220	3,460	7,200
	Jul	240	1,420	18,020	52,380	20,980	50,500	14,920	31,960	920	3,740
	Aug	580	1,180	30,280	34,360	14,060	29,520	6,520	17,040	2,720	2,820
	Sep	600	600	4,080	4,080	15,460	15,460	10,520	10,520	100	100

APPENDIX C. Simulated wholesale prices in dollars per pound for red king crab legs and claws under historical conditions and three reduced size limit scenarios.

Year	Month	Red 9/12				Red 12/14				Red 14/16			
		Hist	Scenario			Hist	Scenario			Hist	Scenario		
			1	2	3		1	2	3		1	2	3
1987	Oct	10.66	10.68	10.75	10.65	9.84	9.86	9.87	9.83	9.10	9.09	9.09	9.06
	Nov	10.81	10.83	10.90	10.81	9.95	9.96	9.97	9.93	9.20	9.19	9.19	9.16
	Dec	10.66	10.68	10.75	10.66	9.89	9.90	9.91	9.87	9.18	9.18	9.18	9.15
1988	Jan	10.48	10.50	10.57	10.48	9.86	9.87	9.88	9.85	9.16	9.16	9.16	9.13
	Feb	10.29	10.30	10.37	10.28	9.79	9.80	9.81	9.78	9.15	9.14	9.15	9.12
	Mar	10.30	10.31	10.37	10.29	9.81	9.82	9.83	9.80	9.21	9.20	9.21	9.18
	Apr	10.32	10.34	10.40	10.32	9.85	9.86	9.87	9.84	9.29	9.29	9.29	9.27
	May	10.39	10.41	10.46	10.39	9.94	9.95	9.96	9.93	9.41	9.40	9.40	9.39
	Jun	10.35	10.36	10.41	10.34	9.95	9.95	9.96	9.94	9.47	9.45	9.46	9.44
	Jul	10.22	10.23	10.28	10.21	9.94	9.94	9.95	9.94	9.50	9.48	9.49	9.48
	Aug	10.18	10.19	10.24	10.18	9.96	9.96	9.97	9.96	9.53	9.51	9.52	9.51
	Sep	10.21	10.21	10.22	10.21	9.96	9.95	9.96	9.95	9.52	9.51	9.51	9.51
	Oct	11.51	11.52	11.58	11.51	11.61	11.62	11.63	11.60	11.09	11.09	11.09	11.06
	Nov	11.90	11.91	11.96	11.90	11.83	11.84	11.85	11.82	11.27	11.26	11.27	11.24
	Dec	11.99	12.00	12.04	11.99	11.89	11.90	11.91	11.88	11.34	11.34	11.34	11.32
1989	Jan	12.06	12.07	12.09	12.06	11.94	11.95	11.95	11.93	11.40	11.40	11.40	11.38
	Feb	12.10	12.10	12.12	12.09	11.97	11.98	11.98	11.96	11.43	11.43	11.43	11.41
	Mar	12.20	12.20	12.21	12.09	12.05	12.06	12.06	12.04	11.50	11.50	11.50	11.49
	Apr	12.22	12.23	12.24	12.22	12.09	12.10	12.10	12.09	11.56	11.56	11.56	11.55
	May	12.58	12.59	12.59	12.58	12.31	12.31	12.31	12.31	11.75	11.75	11.75	11.74
	Jun	12.78	12.79	12.79	12.78	12.46	12.46	12.46	12.45	11.90	11.90	11.90	11.89
	Jul	12.83	12.83	12.83	12.83	12.51	12.51	12.51	12.51	11.96	11.96	11.96	11.96
	Aug	12.96	12.96	12.97	12.96	12.61	12.61	12.61	12.61	12.05	12.05	12.05	12.05
	Sep	13.10	13.10	13.10	13.10	12.72	12.72	12.72	12.72	12.14	12.14	12.14	12.14

(Continued)

APPENDIX C. (Continued)

Year	Month	Red 16/20				Red 20/25			
		Hist	Scenario			Hist	Scenario		
			1	2	3		1	2	3
1987	Oct	8.59	8.51	8.51	8.48	7.53	6.65	6.65	6.64
	Nov	8.70	8.63	8.62	8.60	7.67	6.81	6.81	6.80
	Dec	8.70	8.62	8.62	8.60	7.69	6.91	6.90	6.90
1988	Jan	8.63	8.56	8.56	8.53	7.60	6.83	6.83	6.83
	Feb	8.60	8.54	8.54	8.51	7.65	6.99	6.99	6.99
	Mar	8.69	8.63	8.63	8.61	7.67	7.02	7.02	7.02
	Apr	8.81	8.76	8.76	8.75	7.92	7.41	7.41	7.41
	May	8.92	8.86	8.86	8.85	7.96	7.46	7.46	7.45
	Jun	8.95	8.90	8.90	8.89	7.96	7.46	7.46	7.46
	Jul	8.95	8.90	8.90	8.89	7.97	7.53	7.53	7.53
	Aug	8.97	8.92	8.92	8.92	8.05	7.69	7.69	7.69
	Sep	8.93	8.90	8.90	8.90	8.14	7.91	7.91	7.90
	Oct	10.16	10.10	10.10	10.07	9.03	8.38	8.38	8.38
	Nov	10.39	10.34	10.33	10.31	9.34	8.74	8.74	8.73
	Dec	10.48	10.45	10.45	10.43	9.58	9.14	9.14	9.14
1989	Jan	10.53	10.51	10.50	10.49	9.68	9.31	9.31	9.31
	Feb	10.57	10.54	10.54	10.53	9.73	9.37	9.37	9.37
	Mar	10.64	10.61	10.61	10.59	9.79	9.46	9.46	9.45
	Apr	10.73	10.71	10.71	10.70	9.99	9.78	9.78	9.78
	May	10.97	10.96	10.96	10.95	10.31	10.17	10.17	10.17
	Jun	11.15	11.14	11.14	11.13	10.47	10.36	10.36	10.36
	Jul	11.23	11.23	11.23	11.22	10.58	10.52	10.52	10.52
	Aug	11.33	11.33	11.33	11.33	10.69	10.64	10.64	10.64
	Sep	11.43	11.43	11.43	11.43	10.83	10.83	10.83	10.83